THE STUDY OF SOME MORPHOLOGICAL CHARACTERS AT THE *ARISTICHTHYS NOBILIS* SPECIES IN DIFFERENT STAGES OF DEVELOPMENT

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Abstract

 *The work aimed to the study of some bodily variables at the three summer-old, respectively, four summer-old **Aristichthys nobilis** (bighead carp) representatives, derived from a systematic arrangement. For that, were used a number of a 100 individuals for each age in part, determining a series of morphological characters, such as: the body's total and standard length, the head's length, the height, the body's circumference and weight. Thus, for each pair of analyzed variable (the body's standard length in regard with the head's length, the body's total length and weight, respectively, the height in regard with the body's circumference), was calculated the Pearson index of parametric correlation, being then tested the signification of this one. The values of **t calculated** were compared with those of **t critic** (α=0.05, n-2) = 1.985, establishing the null hypothesis (that doesn't exist correlation) and alternatives (that exists correlation), and on the basis of the comparing of **t calculated** value with **critical t** was accepted one of the two hypothesis. Hereinafter was traced the straight line of regression and the regression equation of the straight line, then was determined the coefficient of regression, that is in what measure a variable determines the increasing of the other variable as well as the determination coefficient (R^2) which denotes how percent from the values took of the dependent variable are determined of the independent one and reciprocal. The statistical analysis denotes the existence of some positive correlations between all the pairs of morphological characters studied, with the mention that at the three summer-old bighead carp the correlation between the body's standard and total length resulted to be the most significantly statistic (r=0.966), while at the four summer-old representatives on the first place is the correlation between the body's circumference and height (r=0.996).*

 Key words: morphological characters, bighead, correlation, regression

INTRODUCTION

 The bighead carp, alongside grass carp (*Ctenopharyngodon idella*), black carp (*Mylopharyngodon piceus*) and silver carp (*Hypophthalmichthys molitrix*) represents the main cultured species in China, the common carp being a secondary species [1].

 The refer data to consumption ratio of the food in bighead carp are less, but it is known that this species, as well as the others carps from the Chinese complex, is piggish. Some authors [4] show that the daily ratio (relation between the totally ingested food in one day and the fish weight) is of 6.6%, while after others [5, 6] oscillates between 7.2 - 11.3%.

 It can get a corporal mass of approximately 26 kg or more. After the age of 4 years it can get to a weight of 9 - 11 kg. In the case of the rich tank in food, at 5 years were registered weights between 12 and 15 kg, and at 6 years up to 20 kg. The biggest record in the world was of 33 kg weight and 142.24 cm length, with a circumference of 88.9 cm [7].

MATERIALS AND METHOD

 It was worked on a number of 100 exemplars three summer-old respectively, four summer-old *Aristichthys nobilis*, derived from a system of supervised growth. It were done measurements, the main followed morphological characters being total and standard length of the body, length of the head, height, circumference and weight of the

body, and finally all the obtained results were statistically interpreted. Thus, were determined values of the most representatives statistical indices as average, error and standard deviation, median, variance, confidence level, mean variation and precision coefficient [2, 3]. Also, were supervised the correlation and regression relations between the different pairs of bodily variables, establishing the number of cases in which the respectively relations are respected [8, 9].

RESULTS AND DISCUSSION

From the presented data in Table I it can be observed that in three summer-old *Aristichthys nobilis* population, the maximum total length is of 59 cm, and the maximum weight of 2000 g. The biggest variation coefficient (14.359%) was dignified in the case of bodily mean weight, and the smaller value in the case of total mean length of the body (6.443%).

Table I. Values of the main statistical indices bodily variables in three summer-old *Aristichthys nobilis*

Statistical indices	Bodily variables					
	L (cm)	ls (cm)	lc (cm)	H (cm)	Ci (cm)	G (g)
Average	52.36	44.475	13.91	13.497	29.25	1702.5
Standard error	0.337	0.324	0.133	0.136	0.264	24.447
Median	52	44	14	13.4	30	1700
Mode	51.5	44	14	13	31	2000
Standard deviation	3.374	3.24	1.339	1.367	2.649	244.471
Variance	11.384	10.501	1.794	1.868	7.017	59766.41
Range	16	17	9	8	16.5	800
Confidence level (95%)	0.669	0.643	0.265	0.271	0.525	48.508
Upper limit	53.029	45.118	14.175	13.768	29.775	1751.008
Lower limit	51.69	43.831	13.644	13.225	28.724	1653.992
VC%	6.443	7.826	9.631	10.128	9.056	14.359
m%	0.644	0.728	0.963	1.012	0.905	1.435

L = bodily total length, ls = standard length, lc = length of the head,
H = bodily maximum height, Ci = circumference, G = weight,
VC% = average variation coefficient, m% = average precision coefficient

For all pairs of variables taken into study, the analysis of correlation emerged to the acceptation of the alternative hypothesis, namely there are positive correlations (*calculated t* being in all cases bigger than *critical t*).

Pearson correlation coefficient between standard length of the body and length of the head is of 0.599, and the determination factor viewed in graphic (Fig. 1) shows that this type of relation is valid in only 35.9% of cases.
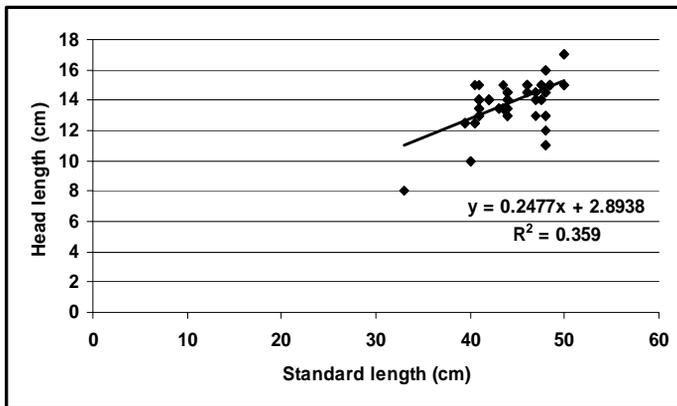

Fig.1. Graphical representation of the regression between standard bodily length and head length in three summer-old *Aristichthys nobilis*

According to the calculated regression coefficient values we can say that:
- at an 1 cm increase of standard bodily length, the head length increases with 0.247 cm;
- at an 1 cm increase of head length, the standard length of the body increases with 1.449 cm.

In what concerns the correlation between standard length and bodily weight (r=0.762), the calculated regression coefficients for this type of connection show that:
- at an 1 cm increase of standard length, the weight of the body increases with 57.499 g;
- at an 1 g increase of weight, the standard length of the body increases with 0.01 cm.

The determination factor established that the values taken of the two variables are determined one by another in 58.09% of cases (Fig. 2).
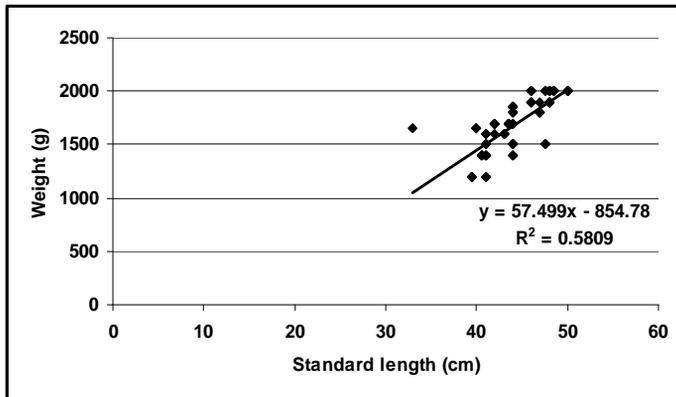

Fig.2. Graphical representation of the regression between standard length and bodily weight in three summer-old *Aristichthys nobilis*

The strongest correlation, significantly from the statistic point of view, was registered between standard length and total length of the body, the Pearson correlation coefficient having an appropriated value of maximum (0.966).
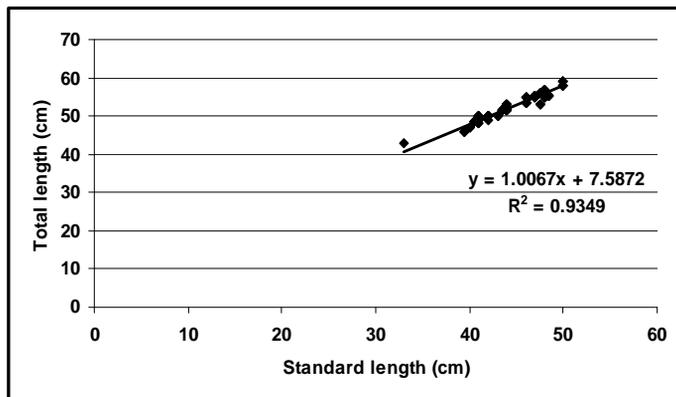

Fig.3. Graphical representation of the regression between standard length and total bodily length in three summer-old *Aristichthys nobilis*

The obtained regression coefficients established that:
- at an 1 cm increase of standard length, the total length of the body increases with 1.006 cm;
- at an 1 cm increase of total length, the standard length of the body increases with 0.928 cm.

The determination factor estimates that the taken values of the standard length are determined from the total length of the body and reciprocally in 93.49% of cases (Fig. 3).

In this stage of development, a positive correlation is pointed out also between height and bodily circumference, the correlation coefficient getting a value of 0.782. The determination factor established that this type of relation is met in 61.24% of cases (Fig. 4).
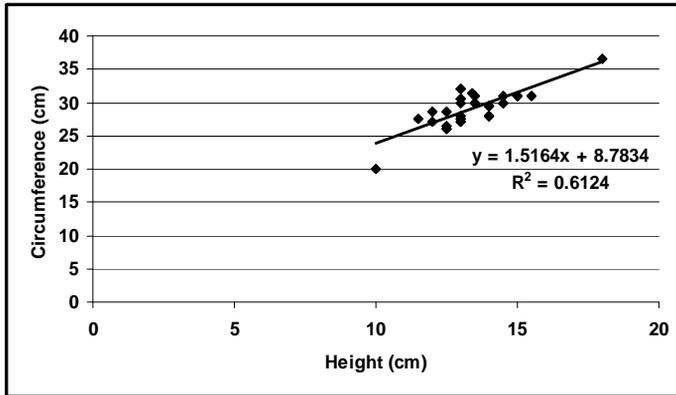

Fig.4. Graphical representation of the regression between
height and bodily circumference in three summer-old *Aristichthys nobilis*

The obtained regression coefficients underlined the following observations:
- at an 1 cm increase of height, the bodily circumference increases with 1.516 cm;
- at an 1 cm increase of circumference, the height of the body increases with 0.403 cm.

In four summer-old bighead carp exemplars, the same as in the case of those of three summer-old, higher values of variance, standard deviation and standard error is registered by the total length, standard length, circumference and weight of the body (Table II).

In what concerns the mean variation coefficient, in this last stage of development taken into study, the highest value was observed in the case of bodily mean weight, and the minimum level was achieved in bodily mean circumference (11.22%). In this stage of development the total length gets the maximum value of 75 cm, while the maximum level of bodily mass is of 4200 g.

Table II. Values of the main statistical indices bodily variables in four summer-old *Aristichthys nobilis*

Statistical indices	Bodily variables					
	L (cm)	ls (cm)	lc (cm)	H (cm)	Ci (cm)	G (g)
Average	64.555	56.33	18.115	20.255	41.395	3278.5
Standard error	0.793	0.648	0.246	0.236	0.464	54.086
Median	67	58	18	20.5	41	3300
Mode	69	48	20	21	42.5	3400
Standard deviation	7.93	6.487	2.464	2.361	4.644	540.867
Variance	62.898	42.081	6.075	5.578	21.572	292538.1
Range	22	18	9	7	14	1600
Confidence level (95%)	1.573	1.287	0.489	0.468	0.921	107.319
Upper limit	66.128	57.617	18.604	20.723	42.316	3385.82
Lower limit	62.981	55.042	17.625	19.786	40.473	3171.18
VC%	12.285	11.516	13.606	11.66	11.22	16.497
m%	1.228	1.151	1.36	1.166	1.122	1.649

L = bodily total length, ls = standard length, lc = length of the head,
H = bodily maximum height, Ci = circumference, G = weight,
VC% = average variation coefficient, m% = average precision coefficient

As to the assay Pearson correlation index signification between the different pairs of investigated external variables, was discovered that in all cases the *calculated t* value is more bigger comparatively with that of *critical t*, fact that emerged this time again to the rejection of the null hypothesis and the acceptance of the alternative one, according to which there are positive correlations between the all tested variables.

In four summer-old *Aristichthys nobilis* exemplars we can observe the existence of some stronger connections between all pairs of analyzed variables, namely of some significantly positive correlations from a statistic point of view.

The correlation coefficient value between standard length (independent variable) and the length of the head (dependent variable) is of 0.804, and the determination factor (Fig. 5) shows that this relation is valid in 64.75 % of cases.
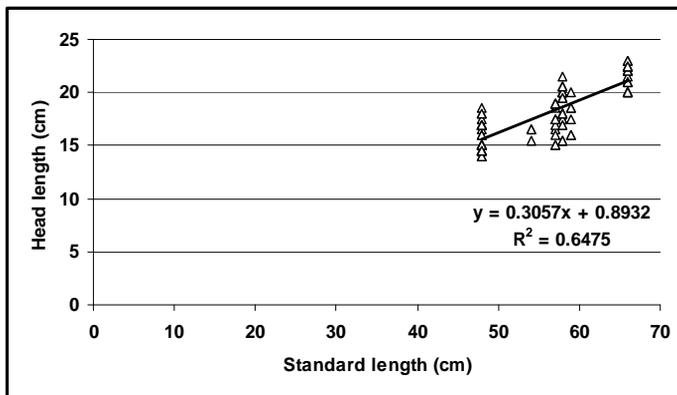

Fig.5. Graphical representation of the regression between standard bodily length and head length in four summer-old *Aristichthys nobilis*

As to the calculated regression coefficients we can say that:
- at an 1 cm increase of standard length of the body, the length of the head increases with 0.305 cm;
- at an 1 cm increase of length of the head, the standard length increases with 2.117 cm.

In what concerns the correlation between standard length and weight of the body, the Pearson correlation coefficient has a value appropriated to the maximum one (r=0.948), fact that underlines a very strong connection between the both variables, valid in 89.93% of cases (Fig.6).

The values of calculated regression coefficients show that:
- at an 1 cm increase of standard length, weight of the body increases with 79.068 g;
- at an 1 g increase of weight, the standard length of the body increases with 0.011cm.

The correlation between total length and standard length of the body is, too, statistically significant, and the determination coefficient shows that the two variables are influencing reciprocally in 94.88% of cases (Fig. 7).

The estimation of regression coefficients evidenced the fallowing:
- at an 1 cm increase of standard length, the total length of the body increases with 1.19 cm;
- at an 1 cm increase of total length, the standard length of the body increases with 0.796 cm.

The strongest correlation was observed between height and bodily circumference (r=0.996), the determination coefficient being in this case of 99.34% (Fig. 8), which denotes that between the two variables the correlation is significantly statistic.
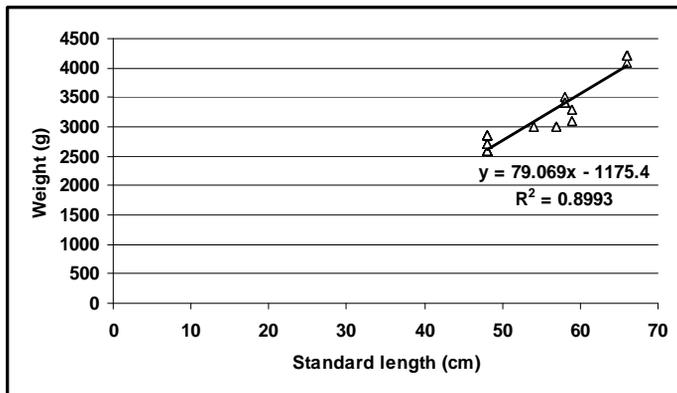
Fig.6. Graphical representation of the regression between standard length and bodily weight in four summer-old *Aristichthys nobilis*
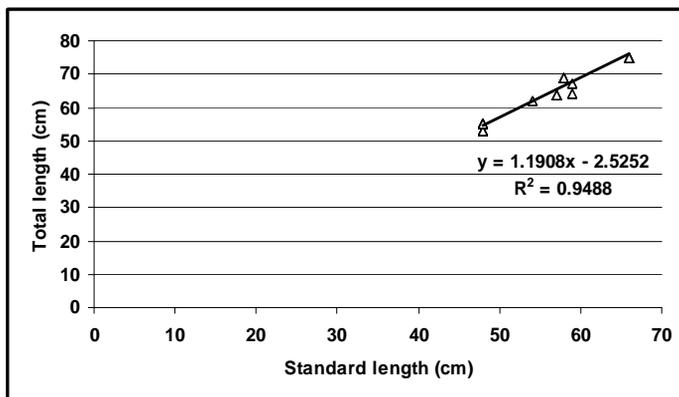

Fig.7. Graphical representation of the regression between standard length and total bodily length in four summer-old *Aristichthys nobilis*

As to the regression correlation values it resulted that:
- at an 1 cm of the height, the circumference of the body increases with 1.966 cm;

- at an 1 cm of the circumference, the height of the body increases with 0.506 cm.
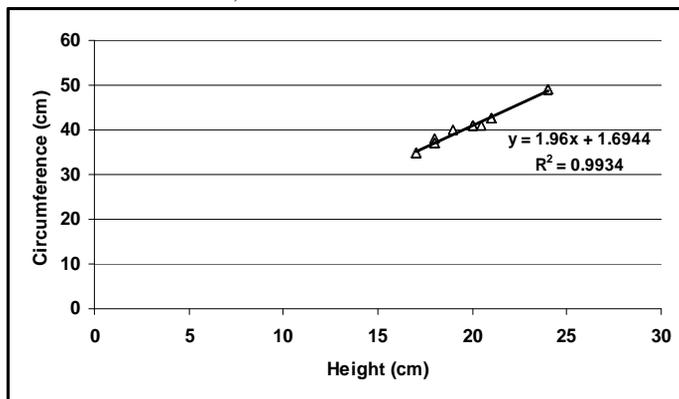

Fig.8. Graphical representation of the regression between height and bodily circumference in four summer-old *Aristichthys nobilis*

CONCLUSIONS

1. The three summer-old bighead carp representatives have, with a probability of 95%, the total mean length between 51.69 and 53.029 cm, the standard mean length between 43.831 - 45.118 cm and a weight mean between 1653.992 - 1.751.008 g. In four summer-old the total mean length of the body oscillates between 62.981 - 66.128 cm, the standard mean length between 55.042 - 57.617 cm, while the mean weight of the body is between 3171.18 and 3385.82 g.

2. For both development stages taken into study it was registered positive correlations between the all pairs of analyzed bodily variables, the most significant from statistical point of view being between standard length and total length of the body in three summer-old exemplars, respectively, between height and bodily circumference in four summer-old population.

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